TO THE SEA IN *Fragments*

By CHESTER STOCK

Dr. F. D. Bode of the California Institute of Technology in Pasadena examines, through the magnifying glass, a few of the horse teeth recovered from the Domengine Creek fossil bed

ABUNDANT evidence prevails along the western border of California that the relation of land to sea has undergone many changes in past geologic time. The ceaseless onslaught of the continental margin by the Pacific Ocean, accompanied by a restlessness on the part of the land, has been largely instrumental in bringing about extensive invasions of the sea during the long periods of the geologic past. Commonplace though the evidence may be to the geologist, the facts that point to the former presence of the sea where now exists only dry land are sometimes startling in their revelation to the layman.

Nowhere are the marine-laid formations with their entombed remains of sea organisms more clearly brought to view than in the Coast Range of California. Here the rocks disclose a history in which repeated subsidences, marine inundations, and uplifts of the land surface form some of the principal chapters. Occasionally, land-laid deposits are found interbedded with the marine formations and in these are sometimes encountered remains of land animals.

An unusually interesting occurrence of this type, readily accessible to the autoist who likes to explore, is found in the Diablo Range, north of Coalinga in western Fresno County. The region is well known to those who read the story of the rocks and likewise possesses economic importance since it was early recognized as one from which petroleum could be obtained. Extending for miles along the eastern flank of the mountains are a number of geologic formations, each fairly distinctive as to rock type and each quite well defined with reference to underlying and overlying rock layers. In many places on this side of the range one may observe the inclined strata, like cards in a tilted deck, sloping away in an easterly direction, to disappear beneath the floor of the Great Valley of California.

A number of streams, now intermittent in flow because of a prevailing dry climate, cut into these rocks in their course to the San Joaquin plain. Domengine Creek, named after a rancher who settled in the region during the early 'eighties, is a stream of this type. Along its drainage path, some 12 miles north of Coalinga, are exposed light-colored, marine-laid formations, but interbedded with these is a deposit of different hue and origin known locally as the Rainbow Beds or the Big Blue because of its dominant color characteristics.

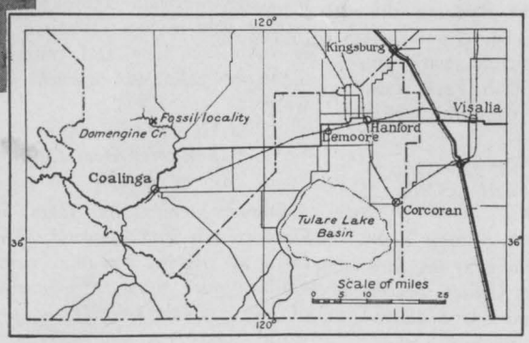
Some years ago a group of students were examining the succession of strata on Domengine Creek when two of their number, climbing up the east bank of the stream to examine the rock exposures

more closely, picked up several fossilized horse teeth that had weathered out of the sediments. This accidental discovery led to a more intensive search with the result that a narrow zone, several feet in thickness and rich in fossil remains, was recognized as occurring near the top of a marine-laid formation, called the Temblor by geologists, and immediately below the deposits known as the Big Blue. With later exploration this bed was followed laterally for several hundred feet and fossil bones and teeth were uncovered at a number of localities within that distance.

The bed itself is made up of rather loosely consolidated pebble lenses and sand. In these sediments are preserved the remains of many different kinds of extinct land animals which we now know date from within the geologic epoch called the Miocene, perhaps ten to twenty millions of years back in time. Several curious features distinguish the occurrence from others that have been found in the State. For one thing, while most of the animal remains are of land mammals, with them are found occasionally remains of creatures that dwelt in the sea. Another feature is that presented by the preservation of the material. Skulls and the larger parts of a mammal skeleton are not preserved complete, but the hard compact structures like the smaller bones of the body and particularly the teeth frequently are found intact. The teeth especially exhibit a beautiful brown or amber color, acquired through long burial in the sediments, giving the specimens a very distinctive appearance. The abundance of certain kinds of fossilized remains is also striking. Literally thousands of individual horse teeth, for example, have been unearthed from this stratum, and the supply seems by no means exhausted.

Study of the deposit and of the animal life entombed in the sediments leads to the conclusion that the formation was laid down originally under conditions prevailing along a sea coast, perhaps in a lagoon or in an estuary, but apparently near the outlet of a stream, where the materials brought down by a river were allowed to accumulate in salt or brackish water at shallow depths. The peculiar mixing of remains of land animals with those of creatures normally dwelling in salt or brackish water, like sea-cows, bony fishes, sharks, rays and mollusks, is accounted for in this way. However, extinct species of three-toed horses make up more than 60 per cent of the entire animal population. Many of these creatures were no longer than Shetland ponies. Most of the horses were grazing animals like their living descendants, but with them occur more primitive browsing forms. About 15 additional kinds of animals have been uncovered, including rhinoceroses, peccaries, camels, primitive deer-like creatures, mastodonts, an early beaver, and among the predatory forms, a cat, giant dogs and other members of the canid tribe that were more like coyotes in size.

Evidently the river responsible for the laying down of this remarkable record derived the materials along its line of flow. While it is not possible to trace the course of this ancient stream, some interesting facts can be ascertained from the occurrence regarding the environment of the back country through which it flowed. Thus, the climate must have been less arid when the river was in existence than is the case today in this area of the Diablo Range. With greater rainfall a vegetational cover was available to meet the needs of large herds of horses and of the varied group of herbivorous mammals associated with them. These in turn were preyed upon by carnivores. Perhaps seasons of flood water were responsible for many casualties among the creatures living adjacent to the stream. Regardless of whether death ensued from accident or not, the yield of organic remains carried down by the river and deposited at its mouth must have been large. In the process of transportation and final burial much of the material was totally destroyed or battered and broken, but many fragments are still preserved to tell the story.



Above is a scientific worker digging for fossils in the Domengine deposits. At the right is a map showing the location in reference to present-day roads and communities. Passing through Kingsburg and between Hanford and Visalia is US Highway 99, inland route to the North

Below is a general panorama of the Domengine Creek field. The scars on the hillsides, made by excavated sediments dumped down the slopes, mark the sites of fossil diggings